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PATHOPHYSIOLOGIC CONSIDERATIONS IN THE EVALUATION OF THE STROKE PATIENT

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Introduction

THIS presentation has been entitled "Stroke" and this is a lay term which dramatically signifies that the patient has been suddenly struck down by disease. Traditionally, the patient is presented as having a hemiplegia, a paralysis involving the contralateral arm and leg. However, Webster defines stroke or apoplexy as *the sudden diminution or loss of consciousness, sensation and voluntary motion caused by the rupture or obstruction of an artery of the brain.* This definition seems especially appropriate for it signifies that at least three spheres of function are disturbed; namely, consciousness, sensation and voluntary motion (Figure 1). This is a basic principle in the evaluation and management of these patients and, therefore, we shall return to it.

In recent years there has been a marked increase of interest in the study of cerebrovascular disease and the concomitant stroke syndrome. Many factors have contributed to the growth of research in this area. The sheer magnitude of the problem warrants reflection, for vascular disease of the nervous system is the third most common cause of death in this country and accounts for 11.5 per cent of the annual mortality figure.[1] According to Adams, cerebrovascular lesions are found in 25

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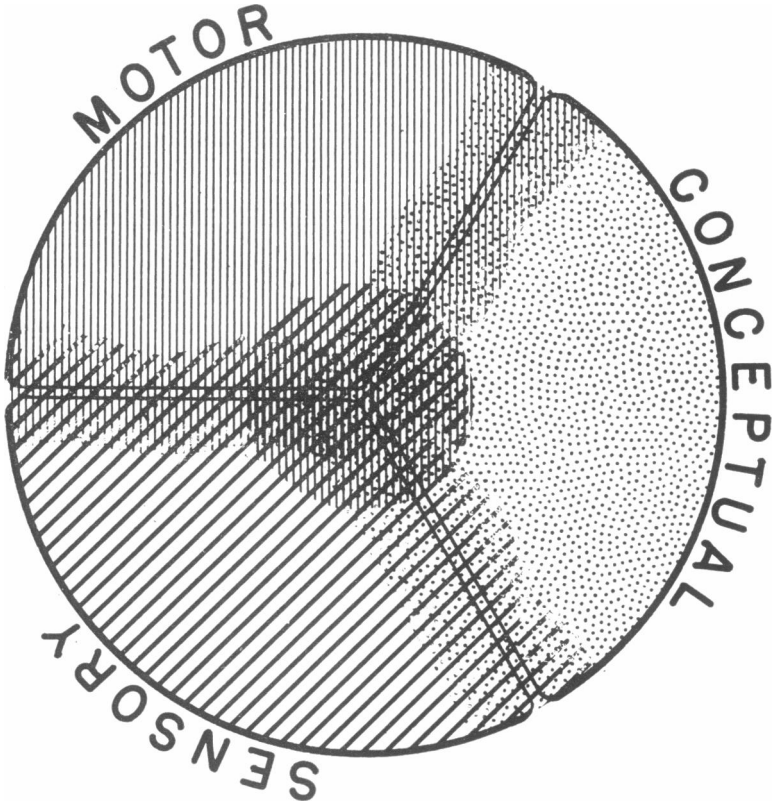

Fig. 1

per cent of routine autopsies in a general hospital.[2] Further, it has been estimated that there are approximately 2,000,000 people in this country who have had a stroke.[3]

A second reason for the increased interest in this subject relates to significant claims that have been made relatively recently for definitive measures in influencing the underlying vascular pathology.

It is now 300 years since Willis published his tract on the cerebral circulation. In the intervening years, wide gaps have remained concerning the pathophysiology of cerebrovascular disease, and little has existed in our therapeutic armamentarium to prevent or correct the underlying pathology.

The major types of cerebral vascular disease are:

1. Cerebral thrombosis associated with atherosclerosis

2. Cerebral embolism secondary to heart disease
3. Cerebral hemorrhage due to hypertension
4. Cerebral hemorrhage due to ruptured aneurysm or angioma.

As you see, the first two of these conditions are related to occlusion of the lumen of vessels. These are the conditions that have been most carefully studied relative to the use of anticoagulants and vascular surgery. Anticoagulant therapy attempts to inhibit the formation of a clot in the vicinity of an atherosclerotic plaque. The formation of such a thrombus could lead to a complete vessel closure and result in ischemia. Another approach to the problem has been the possible dissolution of a thrombus that has already formed through use of thrombolysins.

Three classes of thrombotic stroke have been categorized:

1. Transient ischemic attacks
2. Thrombosis in evolution
3. Completed stroke

In transient ischemic attacks the loss is a temporary one with recovery occurring in a matter of minutes to hours. Thrombosis in evolution signifies a progressive neurological impairment over a period of hours or days. Completed stroke refers to a neurological deficit that has stabilized.

A second major therapeutic approach to these conditions has been the development of vascular surgical techniques of the neck region. Twenty-five per cent of all ischemic attacks are believed to have their origin in the neck where the lesion may be accessible to surgery.

An extensive literature has grown on the efficacy, indications and hazards associated with the use of anticoagulants and with vascular surgery. Discussion concerning anticoagulants has acquired the overtones of partisan controversy which defeats the atmosphere of objective inquiry. However, what has been perhaps the most important contribution of these procedures, relates to the stimulus they have given to the study of the extracerebral circulation. Data concerning the patency of these vessels, specifically the carotid and basilar vertebral arterial trees, are accruing so that more definitive measures of prevention and treatment of stroke may yet evolve.

We have mentioned thus far two factors which have caused marked increase in interest in cerebrovascular disease; namely, the magnitude of the problem and new developments in research and definitive medical management. Finally, there is a third factor.

The field of Physical Medicine and Rehabilitation has contributed much to developing a renewed interest in this subject by providing a more hopeful orientation in the management of the hemiplegic.

For example, in 1957, we studied 232 cases of cerebrovascular accident who were admitted during a one-year period to a 1,000-bed municipal hospital.[4] These cases represented 4 per cent of all medical admissions. At our hospital, a comprehensive rehabilitation program was available and we found that 3 per cent of surviving patients were totally dependent; whereas in a similar study of functional recovery in which no formal rehabilitation program was available, 18 per cent were designated as being totally dependent.[5] The significant difference in the two groups may have been related, we believe, to the availability of a more comprehensive rehabilitation program to our patients.

More recently, Adams and Merrett[6] in Belfast, Ireland, have studied prognosis and survival in a series of 736 patients with hemiplegia of vascular origin who were accepted for rehabilitation two weeks or more after the onset of their strokes. They found that those patients who responded to rehabilitation care and were able to walk, lived longer than those who were incapable of walking alone. In their group of patients they observed that "*the earlier physical retraining began, the better*" the prognosis and survival. Thus, rehabilitation techniques, perhaps, may not only influence the functional return but also the underlying pathophysiology.

I do not intend, for this presentation, to cover a traditional review of the subject of cerebrovascular disease or of hemiplegia. The etiology, pathology and clinical syndrome can readily be obtained from any basic textbook of neurology. Rather, I would like to discuss certain pathophysiologic considerations which may significantly influence the methods to be employed in the rehabilitation evaluation and management of these patients. Under evaluation, we shall discuss sensory disturbances, motor losses, language and psychologic disorders, pain and cardiovascular status. Under management, anticoagulants, trauma, nutrition, and aging will be considered.

Evaluation

The evaluation of the stroke patient, in the past, has often consisted solely of a neurologic examination. This examination attempted to define precisely the locus of a lesion. However, the patient's functional

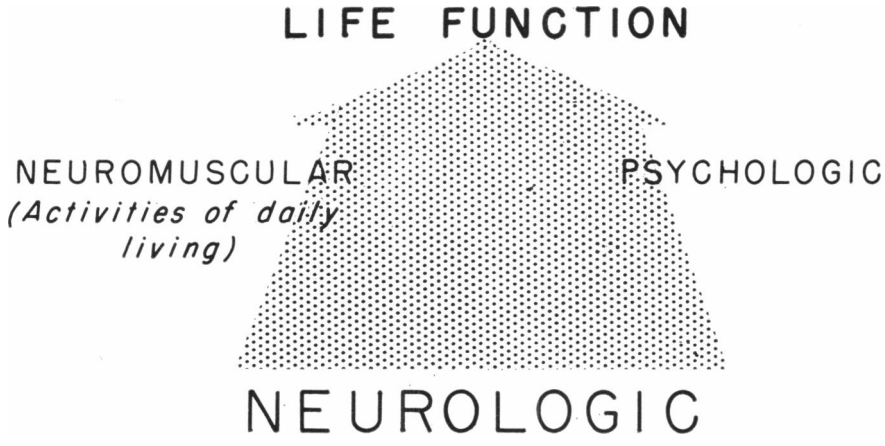

Fig. 2

capacity cannot be adequately revealed by the routine neurological study. For example, the hemiplegic patient in bed may show complete paralysis, but on standing between parallel bars may move the involved lower extremity in the reciprocal motion required in walking. Thus, the neurologic examination may not reveal functional reserves. The functional examination serves to place the emphasis on the patient's residual function rather than upon his deficits. Evaluation should include the following areas of study (Figure 2):

1. General medical status
2. A neurological examination
3. A measure of neuromuscular performance
4. An evaluation of the psychological capacities

Let us review some aspects of each of these areas.

1. *General Medical Status*

All patients who have suffered an acute stroke warrant a general medical examination, especially of the cardiac status.

Many patients presenting with a stroke have cardiac involvement. Bean[7] and others have called attention to the association of acute myocardial infarction with stroke. Glathe and Achor[8] report that 12 per cent in their series of acute stroke patients also had a simultaneous acute myocardial infarction, and further, that 23 per cent had associated acute cardiac disease. Thus, it is apparent that the stroke may be

the direct immediate result of an acute cardiac episode. Early recognition of the accurate diagnosis of the cardiac disease may enable appropriate management to be instituted which may favorably influence the prognosis of the stroke itself. Thus, early ambulation and an activity program of the hemiplegic is often urged.[9] However, in the presence of a recent and *unknown* myocardial infarct, it may be hazardous. Recently, evidence has been presented that the converse of this pathophysiologic relationship may exist. Fentz and Gormsen[10] report nonspecific recent electrocardiogram changes in patients who have suffered an acute cerebrovascular accident that could not be ascribed to the usual cardiac or other extracerebral causes. These changes often simulate myocardial ischemia, or even infarction. Thus, the poetic dichotomy between the brain and the heart is physiologically nonexistent. The cardiovascular status of the patient will determine the rate and extent of his rehabilitation in regard to his motor performance.

As a routine, every patient presenting with a hemiplegia or stroke should have a cardiovascular evaluation including an electrocardiogram. The eventual management will obviously be influenced by these findings.

2. *Neurological Examination*

Let us now consider some sensory aspects of the neurological examination.

In my introductory remarks I commented upon the Webster definition of stroke involving three spheres: consciousness, sensation and motor activity. It must be emphasized that the motor disturbance in the stroke patient is only one aspect of the neurologic deficit. In fact, it is uncommon for deficits to be limited to the motor sphere. The sensory, autonomic and psychological losses may be major determinants of outcome relative to function. All too frequently, the sensory disturbances which these patients experience may be far more significant in terms of motor performance. The losses in the sensory sphere comprise deficits of: 1) the modalities of skin perception (pain, touch, temperature); 2) the subcutaneous structure (sense of position, motion, vibration); and 3) visual perception. Let us discuss some of these phenomena.

Great emphasis is placed upon the motor loss in hemiplegia because the paralysis is so apparent. Many years ago, Sherrington demonstrated that cutting posterior roots which carry afferent sensory stimuli from

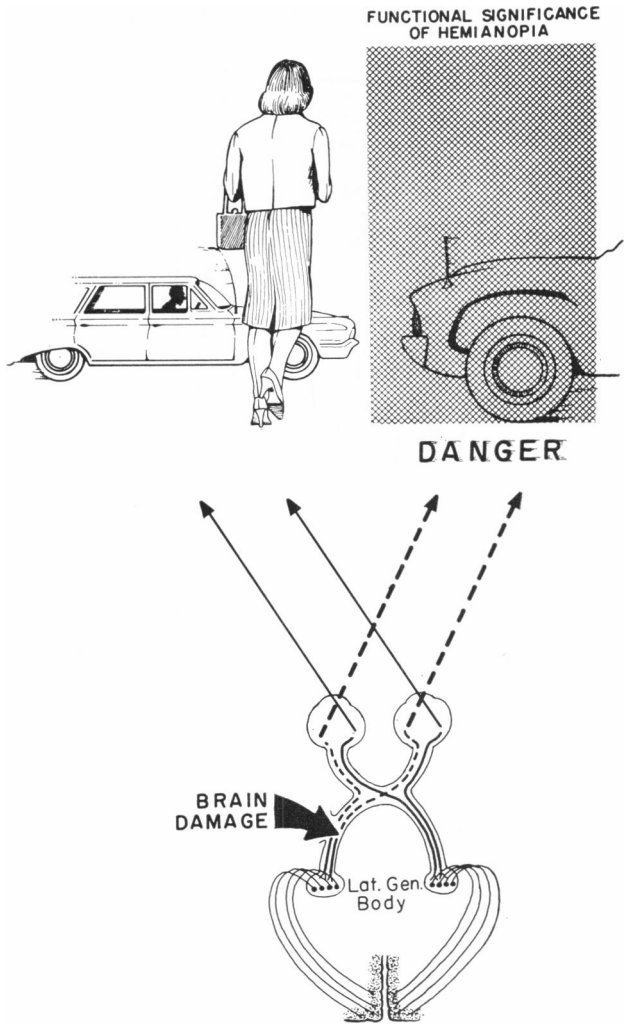

Fig. 3

the upper extremity of a monkey led to complete immobilization of the extremity.[11, 12] By the same token, sensory loss of central origin clinically appears to have a comparable effect. Thus, the stroke patient with a hemisensory loss for position and touch may show as great a motor disability as the patient with a pure, though severe motor paralysis. Prognostically, these patients with severe sensory loss tend to do poorly in terms of regaining motor skills.

Another sensory modality that may be involved is vision. Visual

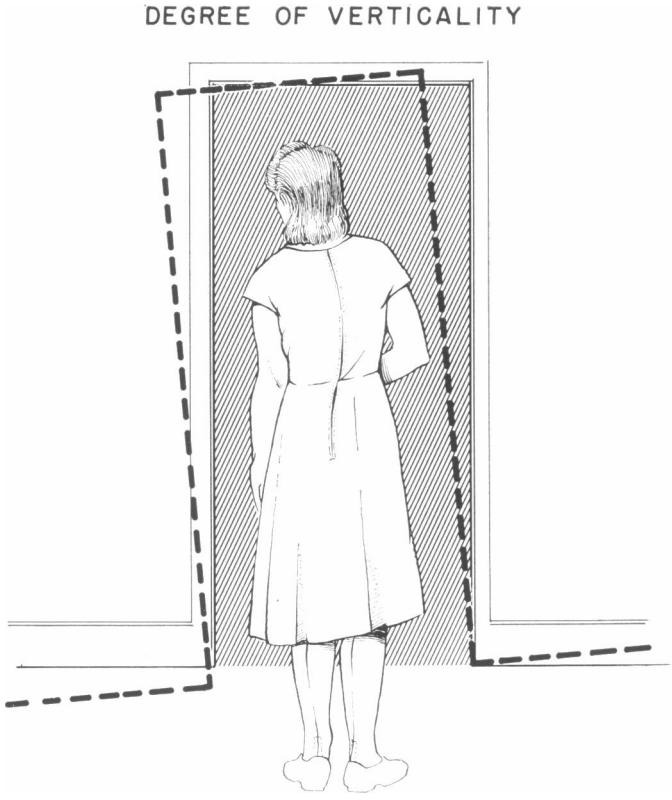

Fig. 4

perception defects in hemiplegia are quite common and prevent the patient from recognizing appropriate cues, thereby interfering with his ability to relearn lost motor skills. Thus, the patient with an homonymous hemianopia has his visual field reduced, so that he can perceive objects in that field only by turning his eyes and head. Such constriction in the visual field may expose the patient to physical hazards, with consequent accident (Figure 3). Further, several reports have appeared in the literature to indicate that hemiplegics may have disturbances in the recognition of depth perception, as well as perception of the vertical and horizontal planes (Figure 4).[13-16] It is possible that such alterations may significantly influence the hemiplegic posture and gait.

Another type of visual disturbance has been reported as occurring more frequently in left-sided hemiplegics. Its presence may seriously compromise the patient's ability to interpret visual stimuli appropriately.

This has been described as construction apraxia.[17] It is associated with an inability to copy simple geometric designs and may possibly contribute to right-left disorientation. Such patients frequently have general intellectual impairment, even though there may be no language disorder. Because these patients present no language disturbance, their intellectual loss is not readily discerned. These phenomena may account for the poorer prognosis that has been observed in the motor performance of many left hemiplegics.[18] We have discussed some of the major sensory disturbances that may be found in hemiplegia. In this framework, we have mentioned motor function as the end result of the sensory input. There are other motor phenomena that I would like to discuss.

3. *Neuromuscular Function*

In the majority of hemiplegics, voluntary movement of the proximal musculature of the involved extremities tends to be more intact than the distal muscles. Thus, the patient may be able to shrug his shoulders or flex his elbow and yet cannot move his wrist or fingers. Presumably, this may account for the fact that the majority of hemiplegics can be taught to stand and walk, although they may be incapable of performing skilled movements of the hand. Standing and walking are gross motor activities placing major demands upon the larger weight-bearing joints of hip and knee.

There are neurophysiologic observations which may provide a basis for these clinical findings. In monkeys, it has been found that hand and finger movements are controlled by large pyramidal fibers which are monosynaptic.[19-21] On the other hand, the upper motor neuron innervation of the proximal musculature, such as the shoulder and hips, reaches the anterior horn cells over polysynaptic tracts. Willed movements for walking involve the trunk and proximal parts of the lower extremity which would require the participation of coordinating polysynaptic reflex mechanisms. Conversely, movements of the hand would require more direct conducting pathways from the cortex. As a result, one might postulate that gait may be initiated in the hemiplegic from the normal hemisphere through the normal leg. The paretic leg might then follow on the basis of postural reflexes at subcortical levels. On the other hand, this mechanism would not be effective for skilled hand movements.

These comments have clinical implications in evaluation. Thus, the determination of motor power in isolated muscle groups in the stroke patient by manual muscle testing may not provide valid information as to his functional capacity. Sometimes it is only possible to determine the patient's capability in this sphere by having him attempt the specific task itself.

4. *Spasticity*

Another important factor which determines the functional status of a hemiplegic is spasticity. In clinical neurology, upper motor neuron disease is almost always equated with spastic paralysis. Parenthetically, it is now known, however, that injury to the motor cortex produces flaccid paralysis and that more "frontal" lesions cause cortical spasticity. Spasticity may develop with any lesion which separates intact efferent neurons from central control. This includes anterior horn cells as well as sympathetic and parasympathetic outflows. Thus, for example, sympathetic overactivity is seen in the hemiplegic in vasomotor and sweating disturbances of the paretic side. There is often no obvious relationship between the intensity of the afferent stimulus and the spastic response. Spasticity may be increased by many factors including a noxious stimulus, cold air, a local infection, anger and excitement. For example, the hemiplegic experiences greater difficulty in walking during cold weather because of increased spasticity. Spasticity may seriously mask the residual motor power. In selected stroke patients who have voluntary movement of an arm or leg, function may be increased if the severe hypertonia, which the patient identifies as stiffness, can be reduced. Under such circumstances, a trial with the use of a nerve block may be diagnostically valuable. Reduction of this spasticity may permit residual motor function to be performed. An obturator nerve block may eliminate adductor spasticity and thus help to reveal the intrinsic motor power present in the lower extremity. Further, according to Rushworth[22] and others, spastic muscles of the hemiplegic may be relaxed by dilute procaine solution which selectively blocks gamma motor fibers.

Spasticity contributes to the abnormal gait and posture of the hemiplegic. The joints tend to be maintained in flexion at the ankle and knee and at the elbow, wrist and hand. This contributes to the development of contractures. The use of a foot board and proper positioning

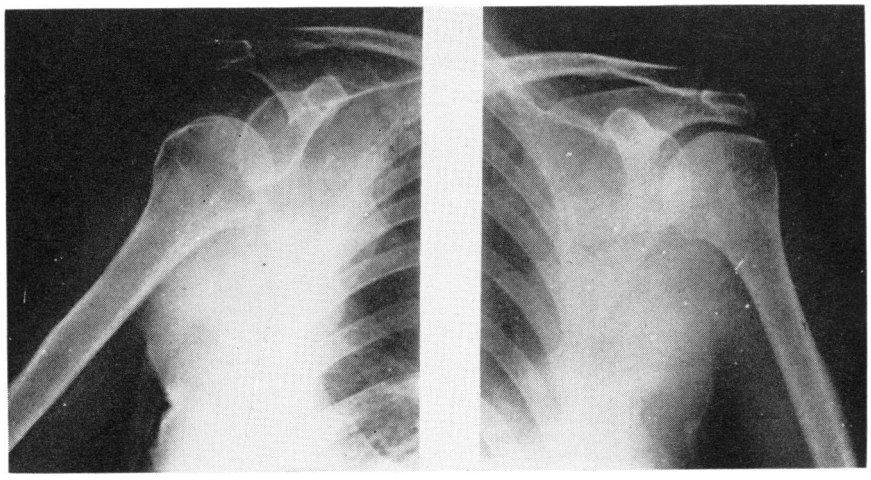

Fig. 5A

in bed, along with passive stretching of the involved joints may help to prevent these deformities. Further, the use of a leg brace may provide stability of both the ankle and knee joints as well as counteract the effects of spasticity.

5. *Pain*

Pain may be another prominent feature in the patient who has suffered a stroke. This complaint may seriously interfere with the rehabilitation process. The pain may be of central origin, as in the thalamic syndrome, and is experienced as a diffuse burning pain. A second type of pain is related to spasticity and produces the feeling of stiffness and tightness upon stretch of the musculature, as has been discussed.

A third type of pain in hemiplegia is seen in shoulder pain. Shoulder pain in the paralyzed arm is a frequent complaint. It is musculoskeletal in origin and usually is the result of subluxation.[23] This may be readily identified by palpating a separation between the glenoid process and the head of the humerus (Figures 5A and B). This is usually seen in patients with severe paralysis of the shoulder musculature and a flail extremity.

It is important to determine the cause of pain in hemiplegia in order to provide effective management. Intractable pain will lead to loss of motivation on the part of the patient in his rehabilitation and, ultimately, to further disability.

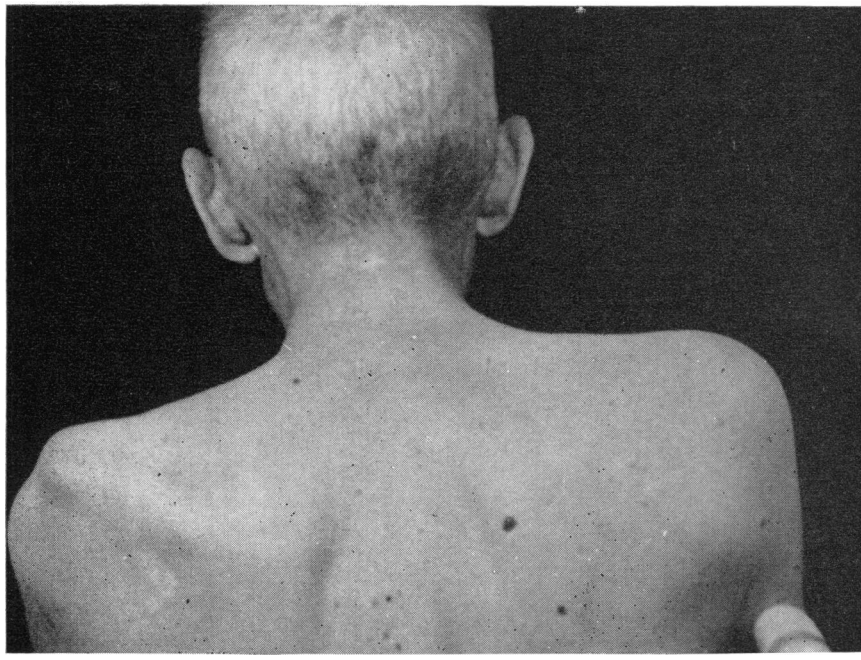

Fig. 5B

6. *Psychological and Language Capacities*

Thus far, we have discussed aspects of hemiplegia that involve the sensorimotor systems. These have included the sensory losses, motor losses, spasticity and pain. There is another major area of deficit in many stroke patients which is not ordinarily considered as related to the motor disability, namely, the language disorder.

It is a century since Broca first correlated language disorder with the posterior aspect of the inferior frontal gyrus of the left hemisphere. Since then, an extensive literature has accumulated on aphasia which has given birth to a vast confused jargon. Neuropathological and neurosurgical approaches have attempted to relate structure to a particular function of speech. All of this has provided enormous data with little rewarding insight into the nature of language function (Figure 6).

There are three closely related phenomena—aphasia, apraxia and agnosia—which have been linked as being expressions of selective loss of memory or concept. Aphasia thus refers to loss of memory for words and sounds. Apraxia presumes the loss of memory associations which

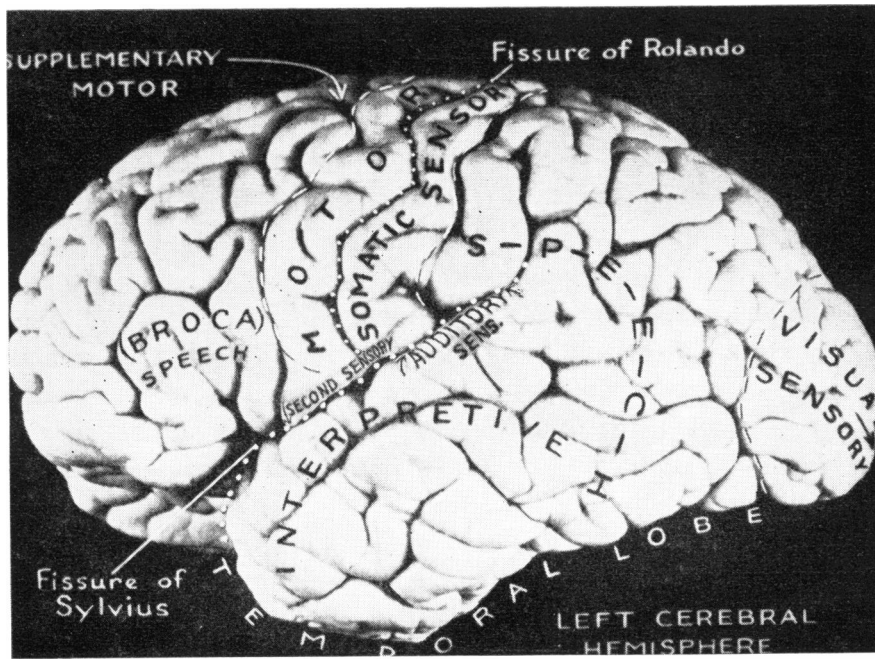

Fig. 6. Left hemisphere of the human brain. Reprinted from p. 40 of *Speech and Brain Mechanisms* by Wilder Penfield and Lamar Roberts, by permission of Princeton University Press. (Copyright © 1959, by Princeton University Press. London: Oxford University Press.)

are needed for carrying out certain purposive movements, not related to speech. Finally, agnosia signifies the loss of recognition of objects. If, for the moment, we were to exclude aphasia from this discussion, it is apparent that the presence of apraxia would be a major factor in interfering with skilled motor acts. By the same token, agnosia might lead, if not to clumsy movements, to inappropriate ones. Thus, language disorders tend to lead to disturbances in motor behavior.

As a physiatrist, I have been especially interested in aphasia in terms of this disturbed motor behavior. Further, the effort to deal with aphasia in the past as a purely psychological or linguistic phenomenon has not provided any effective guide for management. All too often the language disorder is considered as discrete from the motor disability. Yet, there is a basic relationship in normal development, between language and motor skill.

As has been stated by Haldane,[24] "The human brain has two super animal activities: manual skill and logical thought. Manual skill appears

to be the earlier acquisition of the two and the capacity for language and thought has grown up around it." Tools of language develop out of the experience of manual function. It is in this light that emphasis is placed on motor experience as essential for language experience.

Thus, we have observed that many aphasic patients who are permitted to get out of bed and taught to stand and walk often seem to improve their ability to speak or communicate. There would appear to be some relationship between the improvement of musculoskeletal function and improvement in speech function.

Pierre Marie has stated that there is only one aphasia. I am inclined to accept this position, for it helps to clarify and develop a unified approach in the midst of much confusion. Aphasia is one disorder involving many different functions. Thus, there are not qualitatively different types of aphasia, but, rather, different *degrees* of aphasia. Superimposed upon this basic aphasia loss are secondary psychologic concomitants. So, with the severest loss, there may be complete lack of insight. Such a patient may display a lack of self-criticism and appear euphoric. There may be continuous babbling or jargon speech. At a higher level, or as the patient improves, he may develop an awareness of his disability. With this, he becomes more self-conscious and may show laconic speech. He may become much more cautious in his answers and also obviously depressed as he develops insight into his state. The concomitant frustration and depression in the aphasic may thus represent a higher degree of intellectual reorganization.

Other key factors must influence the aphasic picture—the patient's premorbid personality, his education and general intelligence.

As has been stated, aphasia involves a disorder in many functions including motor ones. Thus, the aphasic will have difficulty in performing movements of the tongue and lips, he may show disturbances in gesturing. Bay describes the inability of aphasic patients to mold objects from a plastic material with accuracy. He believes that this disorder is primarily a disturbance in concept formation.

Whatever the explanation, and the literature is replete with explanations and theories, motor disturbance is impaired on careful testing in many spheres of performance of the aphasic. The greater the motor task that the patient can complete, the more likely will he find the means for communication—either verbal or nonverbal. Thus, an activity program for learning to care for one's personal hygiene, to

dressing and undressing, to walking and to carrying out various manual skills may be an empiric approach to the rationale of management. Therapeutic activity, other than speech therapy, may thus become a language experience.

In our program, speech therapy is not restricted to the formal therapeutic sessions provided by a speech therapist. All who provide care for the patient, and who have developed a rapport with him, also provide a form of speech therapy. We believe, therefore, that the physical therapist and occupational therapist, in helping the patient to improve his musculoskeletal function, are helping him to improve his ability for communication.

We have discussed several aspects in the evaluation of the hemiplegic patient. These have included the medical aspects, the neurological examination, the neuromuscular or functional evaluation and finally, the psychological and language factors.

MANAGEMENT

A. *Anticoagulation*

Earlier in this paper we discussed the use of anticoagulants as a newer development in the prevention of thrombus formation.

A discussion of the indications and contraindications for the use of anticoagulants is beyond the scope of this presentation. However, many patients with cerebrovascular disease in this country are being treated with anticoagulant therapy. In developing a graduated exercise program for the rehabilitation of the hemiplegic who is on anticoagulation therapy, it is important that the physician be aware of the attendant risk. The medical literature contains numerous reports of subarachnoid bleeding, intracerebral hemorrhage and subdural hematoma occurring in patients on an anticoagulation regimen, even without previous history of cerebrovascular disease.[25] The risks for the stroke patient are, at least, as great. In the care of the hemiplegic who is very often unstable in his gait, and is readily exposed to trauma in attempting to stand and walk, it is incumbent that special precautions be taken if he is also on anticoagulant therapy.

B. *Trauma*

This instability of gait may produce a risk of trauma to the musculoskeletal system as well. Since hemiplegia is a disability pre-

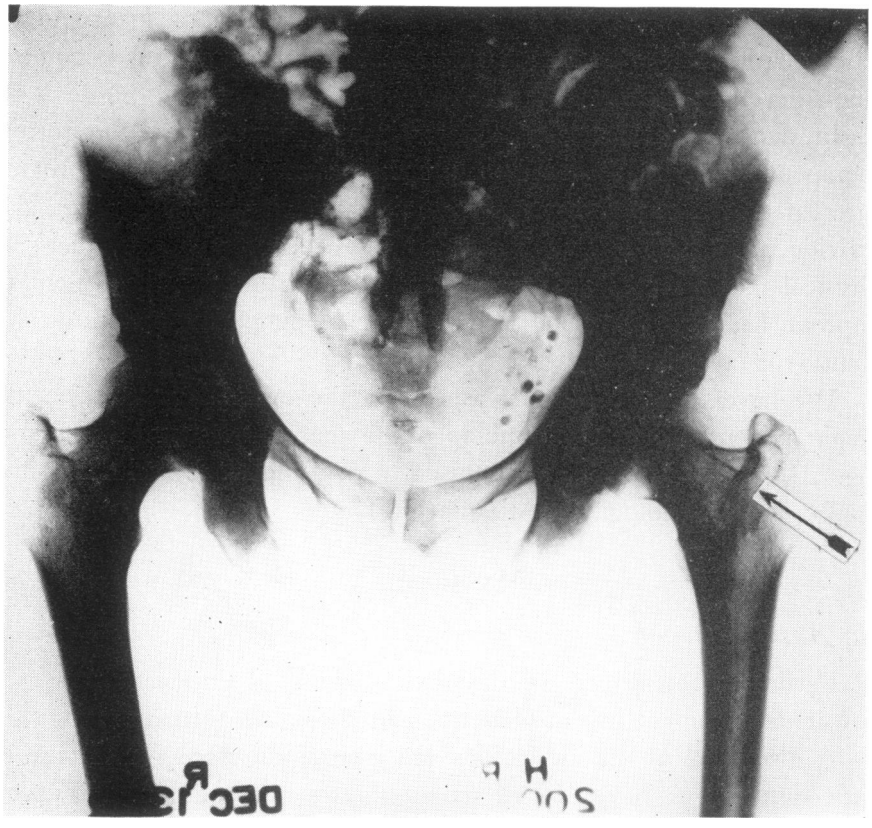

Fig. 7

dominantly seen in the older age groups, osteoporosis is frequently observed among them. It may be especially prominent in the bones of the paretic limbs. Consequently, the risk of fracture is not remote among those stroke patients who learn to walk independently with or without mechanical support (Figure 7). These remarks are not intended to dissuade the use of rehabilitation measures, but rather to recommend their judicious use. By sophist reasoning, one can claim that the safest manner to protect the disabled patient from physical trauma is to make him bedfast. Aside from the serious physiological consequences upon mineral and nitrogen metabolism,[26] the psychological sequelae of such immobilization can lead to further intellectual and emotional deterioration.

C. *Nutrition and Dentition*

As has been stated, speech disorders are a frequent concomitant of a cerebrovascular insult. They are usually seen with involvement of the dominant hemisphere. However, the hemiplegic may show speech disturbances which are not readily identified as being of peripheral origin. All too often, these patients experience an incomplete central facial palsy which produces a thickness of speech. This is compounded by the fact that the patient may be edentulous, or may wear dentures which no longer fit properly. Dentures for the stroke patient often need modification as the result of paretic facial muscles or change in gingival tissues. The speech disorder may thus be the result of mechanical or local factors, rather than of central origin, with its more dour prognosis.

Nutrition is another important aspect of management. Cerebral blood flow is reduced in the elderly.[27] Also, in this type of patient the vascular damage leads to concomitant metabolic cerebral disturbances. In the light of these factors, malnutrition may contribute to the neural disorganization which is often prominent in the intellectual sphere. It is of great importance that an adequate food intake of all essential nutrients is included. The condition of the teeth may determine if a solid diet with adequate protein intake can be ingested. By the same token, the hemiplegic is often incapable of cutting meat by himself and therefore needs assistance in the preparation of his food. Thus, there are many factors which favor a low protein, high carbohydrate and high fluid diet.[28] Since their energy expenditure is minimal, many of these patients tend to become obese in spite of malnutrition. Such obesity is a major deterrent to independence in walking. The nutritional needs of the patients should, therefore, be adequately supervised.

D. *Brain Damage and Aging*

In the psychological sphere these patients frequently suffer the consequences of two underlying pathophysiological processes, namely, the immediate effects of the neural damage, due to the cerebrovascular insult, and long-term changes associated with the aging process. The effects of both these processes upon the personality of the patient are variable. These effects may be either primary, as the direct consequence of cortical disorganization, or secondary, as the reaction of the

individual to his disability.

One special area of immediate concern to the physiatrist relates to the capacity of the patient to learn or re-learn a task. The patient who cannot be taught is incapable of deriving benefit from a rehabilitation program. However, the capacity to learn is very much dependent upon other physiological and environmental factors. As has been stated, physiological and neuromuscular functions are interrelated. The presence of urinary incontinence is usually considered evidence of advanced brain damage. Yet, it is not uncommon to find that, as the incontinent hemiplegic learns to stand and walk again, his bladder control also improves. Therapy which improves neuromuscular function is likely to have a salutary effect upon the psychological status of the patient and may, as has been stated, also help to improve language function.

Environmental factors may significantly influence the patient's intellectual capacities. The metabolic consequences of deconditioning have been well documented. There are also psychologic counterparts. Deconditioning of brain function is likely to occur in an unsympathetic, strange and confusing environment. These stresses, with which the patient cannot cope, will lead to further intellectual disorganization.

All too often, the physician (especially the young house officer) interprets bizarre behavior as purely the result of an organic brain syndrome. Frequently, the term encephalomalacia is assigned with a finality and irreversibility that is tragic, for it establishes an atmosphere of hopelessness and fatalism. Litin[29] has defined the risk of hospitalizing an apparently normal elderly person for diagnostic evaluation. In the case that he describes, this elderly patient became confused, hypomanic and almost moribund, within twenty-four hours after being hospitalized. A very common symptom is disorientation, intensified at night. The disorientation is associated with agitation and panic. In the more severe manifestations, destructiveness and incontinence appear.

Pollack and others[30] have reported on an interesting observation in a study of the double simultaneous stimulation test performed on 293 subjects over 65 years of age in a variety of nursing homes and homes for the aged. Errors of response in this test have been interpreted as due to brain damage. Of special interest in the findings of the study

was the similarity in patterns of response shown by subjects in the same institution. The authors suggest that a subject-institution accommodation occurs as regards intellectual activity. In institutions where almost all the residents had a positive test response, there was an atmosphere of despair and futility. I cite this as an example of how the environment may influence the brain damage.

Aring, a neuropathologist, has written with great wisdom on the subject of senility.[31] He notes that the rate of occurrence of cerebral atherosclerosis in individuals past the age of 50 would almost make it appear to be a normal finding, and yet senility is not a constant in the aged. He emphasizes that social factors, such as isolation, contribute to senile dementia.

Much has been written on the consequences of sensory deprivation, both in the experimental as well as the clinical setting.[32] It has implications in the care of the hemiplegic. With diminished sensory input from hearing, vision, position and touch loss, these hemiplegic patients may experience the consequences of sensory isolation. An unsympathetic environment may only compound the problem.

An optimum environment, on the other hand, is one which will be stimulating but not disruptive, one which is well organized. These patients frequently have difficulty in thinking abstractly. Many may not be able to cope with the complex problems of daily living, but may function effectively in a regularized and simplified setting. For example, some patients may not comprehend the abstract concept of time, but still be able to carry out routine activities on a regular schedule with no confusion.

Some of the pathophysiologic considerations which have been presented in this paper may be of help to any physician who is responsible for the management of the stroke patient. Many of these patients may be treated by the family physician who knows the patient well, in a home setting with which the patient is familiar. Consultation with the physiatrist should be available for special problems that may arise. For the severely involved, admission to a medical rehabilitation service may be required for a limited period of time.

It is hoped that the evaluation of the hemiplegic patient in the framework of these considerations may provide a more rational therapeutic program for his rehabilitation and more realistic goals for the outcome.

Summary

Cerebrovascular disease is the third most common cause of mortality in the nation. It is estimated that there are some 2,000,000 patients who have survived strokes in the United States. This reflects the magnitude of the problem relative to the management of the hemiplegic patient. In the years ahead, this problem is likely to grow in significance for the entire medical profession because of the aging of our population as well as the definitive therapeutic measures (such as anticoagulants and vascular surgery) that have been developed both in the prevention and care of vascular disorders.

The rehabilitation evaluation must take into account the neurophysiologic and psychologic aspects of the patient's status as well as his cardiovascular and musculoskeletal function.

Recent studies have provided information concerning disturbances in perceptual and neuromuscular function which may have significant implications relative to the management and prognosis of these patients.

Rehabilitation principles and techniques should be understood and applied by all physicians. Many of these patients do not require the expertise of the physiatrist and may be satisfactorily managed in their hospital or home setting. Only the severe or special problem may need the skills of the specialist or Rehabilitation Center.

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